Accepted Manuscript

A Systematic Review of Training in Symptom Management in Palliative Care within Postgraduate Medical Curriculums

Pamela Turrillas, MD, MSc, Maria Joao Teixeira, RN, MSc, PhD, Matthew Maddocks, BSc, MCSP, PhD

PII: S0885-3924(18)30504-9

DOI: 10.1016/j.jpainsymman.2018.09.020

Reference: JPS 9888

To appear in: *Journal of Pain and Symptom Management*

Received Date: 14 August 2018

Revised Date: 18 September 2018

Accepted Date: 20 September 2018

Please cite this article as: Turrillas P, Teixeira MJ, Maddocks M, A Systematic Review of Training in Symptom Management in Palliative Care within Postgraduate Medical Curriculums, *Journal of Pain and Symptom Management* (2018), doi: https://doi.org/10.1016/j.jpainsymman.2018.09.020.

A Systematic Review of Training in Symptom Management in Palliative Care within Postgraduate Medical Curriculums

Running title

Review of symptom management training in EoLC

Pamela Turrillas, MD, MSc[1]
Maria Joao Teixeira RN, MSc, PhD[1]
Matthew Maddocks, BSc, MCSP, PhD[1]

[1]King's College London, Cicely Saunders Institute, Department of Palliative Care, Policy, and Rehabilitation, London, UK

Corresponding Author:
Pamela Turrillas, King's College of London, Cicely Saunders Institute, Bessemer Road, London, SE59PJ, United Kingdom
pamela.turrillas@kcl.ac.uk
02078485041

Word Count: 4072
Tables: 2
Figures: 1
Box: 1
Supplementary information: 5
References: 69

Author contributions: All authors contributed for the conception, study design, data collection, data analysis was done by PT and MM. The drafting of the manuscript was done by PT and MT. Studies selection as pilot assessment and data extraction instrument was completed by PT. Full text of all articles meeting the criteria was assessed independently by PT and MT. Contents of the studies were extracted by PT and MT independently. In relation to risk of bias PT and MT independently graded quality and divergences were discussed until consensus was reached.

Disclosure statement: Authors have no intellectual passion, political, religious and institutional affiliations that might lead to a conflict of interest in making this paper.

Acknowledgements: The authors thank colleagues at the Cicely Saunders Institute; Lisa Brighton for strategic support, Mark Willis for technical help, and Alanah Wilkinson for language editing. The authors also thank Camilo Torres for his intellectual discussions on medical education and curriculum.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

INTRODUCTION

According World Health Organisation (WHO) approximately 20.4 million people needed palliative care at the end of life (EoL) in 2011.[1] Chronic non-communicable diseases are the major causes of death and embrace heart disease, cancer, chronic respiratory disease, HIV/AIDS, diabetes as drug-resistant tuberculosis.[1] Nowadays, most end-of-life care (EoLC), defined as care for patients likely to die within the next 12 months,[2] is provided by "generalists" such as general practitioners (GPs) and specialists in clinical areas, whose working remit is not exclusively concerned with the specialist palliative care.[3] A core set of interdisciplinary competencies in palliative care has been defined and established in different countries, in which symptom management is identified as one of the critical areas.[4, 5] Basic symptom management knowledge and skills have been highlighted as areas of particular importance in the training of generalist palliative care providers,[4, 5] although the management of more complicated cases, e.g. refractory pain or existential distress, should ideally be led by a palliative specialist.[4] Several authors suggest addressing knowledge and skills with further training at the undergraduate level, and also, with a collaborative networking between GPs and specialists on palliative care for improving patient outcomes.[6, 7] Education is a potential key to achieve an integrated and collaborative model of care for EoLC.[8] Several studies have demonstrated that palliative care competencies can be adequately addressed through physician education,[9-11] yet studies over the last decade show persistent deficits on attitudes, knowledge and skills through different specialities.[12-15] Further, the prevalence of uncontrolled symptoms at EoL remains high.[5, 16, 17]

Teaching on patient-centred care is a priority at all levels of training.[4] Consequently, substantial efforts have been made to structure programmes of education for all physicians and health professionals from different clinical backgrounds.[18] Despite the high heterogeneity between curriculum formats, almost all the studies show this can lead to improvements in trainees' attitudes, knowledge and skills, and behaviours.[11, 19] There has been an increase in palliative medicine rotations available at postgraduate level, and trainees making use of these report better quality teaching in EoLC and more preparedness to treat patients at the EoL.[8, 15] Despite this, even after a rotation, some physicians in

training felt uncomfortable providing palliative care independently. They perceived several barriers to maintaining adequate EoLC,[14] specifically instructional disparity and lack of expertise, leaving many physicians feeling unprepared to address dying people needs.[20] This reflects the importance of symptom management and the implementation of training for generalists providing palliative care. This comprehensive review aimed to identify and appraise the curriculum, evaluation instruments, and effectiveness of EoLC symptoms management training interventions for generalist palliative care providers.

METHODS

This systematic review was planned and conducted following the recommendations of the Best Evidence Medical Education (BEME) Collaboration,[21-23] and Structured approach to the Reporting in Healthcare Education of Evidence Synthesis (STORIES) statement.[24]

Inclusion and Exclusion Criteria

Participants. Trainee physicians at the postgraduate level, who work or would be expected to work with patients at EoL but not have and are not training for specialist palliative care qualifications, were included. These professionals are often considered as generalist palliative care providers. Examples of potentially eligible areas trainees were working within included anaesthesia, family medicine, internal medicine, cardiology, nephrology, pulmonary disease, geriatrics, gastroenterology, infectious disease, critical care medicine, neurology, paediatrics, psychiatry, radiation therapy, general surgery, surgical critical care, emergency medicine, orthopaedics, obstetrics and gynaecology.

Interventions. Studies related to EoLC training interventions with a symptom assessment or management skill component were included. An objective and clear description of the intervention were required. Any training that addressed pain or non-pain symptoms assessment and management in EoLC was included. Although not an exhaustive list, the interventions covered could embody lectures, workshop, tutorial, feedback, seminar series, problem-based learning, small groups learning, case-based discussion, and other structured teaching sessions. Studies that only included EoLC training interventions without symptom

management training, e.g. communication about prognosis, as well as training interventions delivered to others health care professionals were excluded.

Study Design. Studies were included if effectiveness of the training intervention was tested in a randomised controlled trials (RCTs) and quasi-experimental studies with pre and post-test or interrupted time series. In non-randomised trials, historical, geographical or matched control groups were required. Review articles were excluded, since mismatching interventions, outcomes and incorrect population characteristics have been reported in several systematic reviews.[25] There was no exclusion on the basis on language or year of publication.

Outcomes

This review was based on the Kirkpatrick's model for evaluating educational outcomes (Supplementary Table S1).[21] Reactions, learning and behaviour as primary outcomes were chosen as the most common learning outcomes evaluated in an educational training. This model was further adapted for this review to include, at the fourth-level, patient outcomes or satisfaction with clinical practice as an indicator of care quality.[26] Eligible studies should have undertaken assessments via self-, physician, patient or family assessed instruments, multiple choice exam (MCE), Objective Structured Clinical Examination (OSCE), Standardised Patient (SP), mini-Clinical Evaluation Exercise (mini-CEX), standardised oral exam, written assessment or global rating scale.[27] Unclear or non-validated instruments were not excluded since few standardised outcomes measures exist for evaluating palliative care in medical trainees, and moreover, these had been adjusted according to the objectives of each study.[28]

Information Sources

The following databases were searched for all available years until 30 September 2017: ERIC; MEDLINE; EMBASE; CINAHL via EBSCOhost; PsycINFO via Ovid; Cochrane Database of Systematic Reviews (CDSR) and the WHO international Clinical Trials registered. Post-retrieval of all full-text articles, first author conducted a hand searching, from 1 October to 30 November 2017, through the references of four systematic

reviews about postgraduate training and competencies in end of life were scanned[11, 19, 29, 30] as three other key publications.[4, 20, 31] Where searches found published abstracts but no subsequent full report(s), authors were contacted to obtain full text.

Search

Free text terms for searching titles, abstracts, and key words were combined with database-specific subject headings following the structure of [end of life] AND [symptoms management] AND [training]. See Supplementary Figure S1 for an example search strategy for MEDLINE.

Study Selection

After removal all duplicates, studies were evaluated in stepwise procedure for inclusion in the review. All titles identified in the search were screened for eligibility. For those titles considered potentially eligible, the abstracts were screened by the first author using the inclusion criteria specified previously. Study selection process was described in a trial flow diagram, as outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Figure 1).[32]

Data extraction and management

A first data extraction was performed following Best Evidence Medical Education (BEME) Collaboration recommendations[33] using digital extraction form. Pilot assessment and data extraction was completed by the first author. Revised data sheet was assessed and agreed by a second independent author. Any divergences were resolved via discussion between whole authors until agreement until consensus has been achieved.

Quality assessment.

The quality of the studies included was assessed using the Buckley's quality indicators[34]. This tool was chosen since it has been applicable across a wide-ranging of educational intervention studies. Furthermore, it has been previously applied in BEME systematic reviews enabling comparison with other educational reviews.[34, 35] Tool items consider the study research question, subjects, data collection methods, completeness of the data, control

for confounding, analysis of the results, conclusion, reproducibility, prospective design, ethical issues and triangulation. Cochrane tools for evaluating of RCT[36] and ROBINS-I[37] for non-randomised studies were used to assess the risk of bias. A global rating was determined, and higher quality studies were considered when these met ≥7 out of 11 indicators. We also added one more option to the "yes" or "no" response to make the process of judgement more explicit. This included "Unclear" when author's information was insufficient to make a judgement or when the question was addressed partially. Two authors independently graded quality and divergences were discussed until consensus was reached.

Analyses

Meta-regression analyses at study level were planned to determine which training and evaluation characteristics explained variations in effectiveness of the programs.[38, 39] However, as meta-regression was not possible because of the small number of studies. Therefore, methodological differences were taken into consideration to inform a qualitative analysis of content.[40] Study variables were tabulated for a visual comparison, with available data on the general study (e.g. author, year of publication), study design, target-audience, content related with symptoms, evaluation methods and instruments, key findings, learning impact and authors' conclusions (See Table 1).

RESULTS

Study Selection and Characteristics

Our search identified 5062 references from electronic databases. 73 full-text articles were examined and 5 found eligible. One further study was added after hand searching of references lists from 4 systematic reviews[11, 19, 29, 30] and 3 key publications[4, 20, 31] (Figure 1). The six included studies were published between 2004-2016, and all were conducted in North America[41-46] (Table 1). All were prospective studies; four were pre- and post-test with a control group, including only post-test comparison or only pre-test comparison

related with the control group.[41, 42, 45, 46] Two studies were randomised controlled trials, including one parallel[43] and one cluster design.[44]

Studies were performed within several specialities and included a total of 415 participants from Internal Medicine,[43, 45, 46] Paediatrics,[41] General Surgery,[42] Family Medicine,[44] Radiation Oncology,[44] Neurology[44], Psychiatry[41, 44] and Pathology[44] (Table 2). Overall, the percentage of participants per year of training across studies was 51% postgraduate in year 1 (PGY1),[43-46] 25% PGY2,[41, 42, 44-46] 22% PGY3-4[44-46] and 2% PGY5.[42] The pre-test responder rate ranged between 71-100%, and the post-test from 42-100%.[41, 43-46]

[INSERT 1: Figure 1 PRISMA flow chart]
[INSERT 2: Table 1 Characteristics of included studies]

Methodological quality of included studies

Global rating following the Buckley's quality indicators ranged from 5 [41, 42] to 6 [43-46] out of 11 indicators. All studies had methodological weaknesses according to the criteria set out in the Cochrane Handbook for RCTs and NRSI (Supplementary Table S2 and S3). A summary of the critique is presented in Table 2. High risk of bias were found in all the studies included.[41-46] Major issues related to the lack of a control group and confounding in the design and analysis, especially around co-interventions, contamination, and baseline characteristics of the study subjects, including prior palliative care experience and year of training. Characteristics between responders and non-responders to the evaluation instrument also limited our analysis. This issue was intrinsic to the voluntary and anonymous nature of assessment, which it is difficult to address. An obligatory test could have reduced participation of trainees in the studies.

[INSERT 3: Table 2 Methodological quality of included studies]

Curriculum description

Modes of delivery, duration and training content

A wide variety of interventions were used, including clinical decision support tools such as pocket cards[41, 44] and integrated pathways[45], web-based teaching[43], palliative care rotation[46], and mixed educational methods[42]. Interventions duration ranged from 3 days[42] to one academic year[41]. See further details in Table 1.

Five training interventions were palliative / EoLC courses with a symptom management component,[41-43, 45, 46] and one intervention focused only in pain and non-pain symptom management.[44] Content is summarized in Box 1. Educational interventions also covered additional domains of EoLC, including emotive and cognitive symptoms,[45] communication of bad news[41-43, 46] and prognosis,[41, 46] advance care planning,[43] autonomy,[45] dying process,[41] ethical issues,[42, 46] jeopardy (risk of harm),[42] family support,[42] spirituality,[42] professionalism[43, 46] and economic[45] (Supplementary Box S4).

[INSERT 4: Box 1 Summary of content in pain and symptom management]

Evaluation instruments

Methods of data collection included focus group,[44] and survey questionnaires.[41-46] Surveys questionnaires were self-reported and collected anonymously, except for in two studies.[42, 46] Surveys within four studies examined trainees' reactions[41] and attitudes towards pain and symptom management.[41-45] A 'comfort' section presented in one survey had been validated in previous work.[41] Surveys of attitudes were designed for specific use in three studies,[42-44] and instruments' validity and reliability were not described. Questionnaires were delivered to assess trainees' knowledge about pain and non-pain management. Only one of the studies used a tool identified in previous studies with explicit references without changes on the original instrument.[46] Nevertheless, amendments on original questionnaires were made in three studies and their validations were not described.[41, 42, 45] It was only possible to access one full instrument that with the original version.[45] From the questionnaires most of the multiple choice questions (MCQs) evaluated knowledge at the level of "know" rather than "know how" using "context poor" questions,[41, 44, 45] with limited transferability to complex clinical problems.[27] The period

between pre-test and post-test assessment ranged from three days[42] to one academic year[41], and no study made repeated post-intervention assessments. All except one study[42] used the same instrument in both the pre- and post-training assessments. [41, 43-46]

Effectiveness on trainees' learning outcomes

All educational outcomes evaluated in these studies were in the first[41, 44] and second levels[41-46] of the Kirkpatrick model. In two studies, outcomes were related to participants' views on the learning experience and teaching methods (first level).[41, 44] Four studies measured attitudes (second level A).[41-44] Two RCTs examined change in attitudes or perceptions of trainees' comfort and preparedness before, and after the intervention, and were compared with the control group.[43, 44] Two studies evaluated changes in attitudes in the intervention group, but these results were compared only with the post-test of the control group.[41, 42] All studies aimed to improve trainees' knowledge (second level B) of concepts and principles. Evaluation of thinking and problem solving within the questionnaires was less evident than evaluation of knowledge. All the studies evaluated learning outcome before and after the intervention compared with pre and post-test in the control group in RCTs,[43, 44] and with the pre or post-test in NRSI.[41, 42, 45, 46]

At the first outcome level, trainees' evaluation of the overall curriculum was consistently rated as good or excellent in the usefulness of cards around pain and symptom management.[41] In another study overall trainees' reactions were also positive around having the card at the point of care, the extensiveness of the card, dosages section, and improving confidence.[44] In this study, 90% of physicians in training used the card, the majority between 1-2 times per week, and 10% used it more than five times per week.[44]

In relation to the second outcome level, educational interventions tended to improve trainees' attitudes and knowledge. Clinical decision support tools showed significant improvement in overall comfort levels.[41, 44] However, trainees' attitudes were only reported at the baseline in the use of an integrated clinical pathway, therefore is not possible evaluate trainees' comfort with the change in knowledge.[45] Web-based teaching also improved significantly some of the items evaluating the level of preparedness in the intervention group compared to the control group.[43] On the other hand, in a mixed educational intervention, junior doctors reported less or equal comfort in managing pain and non-pain

symptoms after the intervention compared to senior trainees.[42] Overall knowledge around symptom management domain improved using clinical support tools, web-based teaching and palliative care rotation.[43-46] Furthermore, in the internet-based intervention a dose-response was demonstrated with a significant increase in knowledge for those who read ten or more emails compared to those who read less than ten emails.[43] However, total knowledge scores in pain and non-pain domain were non-significant in two studies when they were compared to more senior residents[41, 42] though some items reached significance difference using a pocket card set.[41]

Effectiveness on patient or family-related outcomes

None of the studies included patient or family-related outcomes in their goals.

DISCUSSION

This systematic review focused on medical postgraduate training interventions designed to improve learning outcomes on symptom management in generalist providers of palliative care. Pain management and non-pain symptom management training interventions were identified. In pain management interventions, the use of opioids and their side effects were main themes covered in training. A wide variety of interventions were used to evaluate trainees' learning outcomes suggests improvements in trainees' reactions, attitudes, and knowledge and skills following training programs. In contrast, the effects on trainees' behaviour, the sustainability of learning, and patient-related outcomes were not examined at all. The shortage of controlled study designs in training programs is consistent with the findings reported by a BEME systematic review around teaching effectiveness in medical education generally.[47]

In relation to the different learning strategies studied, pocket cards were a feasible and effective strategy to improve trainees' comfort and knowledge around symptom control in different specialities, including in long-term interventions one of 6-12 months. [41, 44, 48] These results are consistent with recent research that utilised a pocket reference card for improving care for children at the EoL.[48] Web-based strategies could also be effective, and

address time restrictions that exist nowadays for trainees and faculty.[43] Our findings are supported by studies using similar resources.[49, 50] However, internet-based learning has been associated with positive changes in medical knowledge, but more controversial effects into changes in practice.[51] Order sets, also, suggested positive changes on trainees' knowledge regarding assessment and management of pain and non-pain symptoms[45]. We found that palliative care hospital wards or hospice rotations could improve trainees' knowledge on symptom management.[46] These results are supported by others studies including internal medicine, family medicine and psychiatry residencies.[52-55] The ideal length of rotations to improve learning is unclear, with literature suggesting between one week[52] and six months.[55] The dedicated time in the speciality is probably of most relevance, though this strategy requires a well-coordinated schedule taking into account other parallel rotations, and sometimes, extra-hours work for trainees and faculty.[56]

Despite possible benefits of simulation training[57, 58], this strategy was not found in any studies of this review. For instance, one recent controlled study compared simulation training to didactic education on communication skills and difficult discussions, but with some contents on symptom management, in paediatric fellows.[59] This study suggested that simulation training could improve self-efficacy, but not knowledge compared with didactic education, and most frequent practice is needed to maintain positive changes over time.[59] Although we could not determine the most effective training method, our findings highlight the need to tailor methodologies on the environment, context and resources of each speciality.

A variety of symptom management evaluation tools identified in this review, both qualitative and quantitative[60]. Most survey questionnaires, which evaluated attitudes and knowledge, were modified from previously published instruments or were often created for specific use in the studies. Most of studies used the same instruments with only a short period of time between pre-test and post-test, with a high risk that observed improvements being due to recall. These findings were consistent with the analysis of three systematic reviews.[28, 30, 61] A short length of time between tests could be inadequate to measure changes, for example in knowledge, and give a false impression of ineffective results when

actually could improve another learning outcome over time as behaviours.[62]. This finding highlights the need for a more rigorous evaluation of psychometric properties and design to administer a tool that can capture a "genuine" change in the educational outcome measured. Furthermore, most instruments were self-assessed. Physician self-assessment studies have found a lack of congruence between self-assessment and external observation in clinical skills.[63] Moreover, the worst accuracy in self-assessment among physicians, who were the least skilled and those, were the most confident. This finding was independent of the level of training, speciality, or the domain of self-assessment.[64] This disparity highlighted the crucial need for more patient or family-related outcomes in medical education.[63]

In addition to the instruments used in studies, trainees prior palliative care experience, and year of training are important confounders. Firstly, prior palliative care experience has been associated with less anxiety and more EOL care knowledge.[65] It was also associated with both higher baseline scores and post-test scores, suggesting that previous training in EOL care plays a critical role in physician knowledge and attitudes.[65] Secondly, the year of training has been suggested to be a predictor of post-test knowledge scores.[65] Our systematic review showed contradictory evidence around self-reported comfort or preparedness in managing different symptoms and year of training. While most of the trainees reported an increase in preparedness after the intervention, these were not necessarily significant compared with the control group. Senior residents tend to feel more confident in their level of comfort and preparedness for managing symptoms, despite no differences in knowledge scores compared to junior doctors.[42] Same results were seen in others studies comparing training in neurology residents with faculty members.[66] Measurements of attitudes alone seem to be insufficient in evaluating the true level of the trainee competence.[30]

We could not identify controlled prospective studies to examine the correlation between attitudes and knowledge and change in behaviours. From the literature, cohort studies exploring the transference of knowledge on symptom management and skills into the workplace are equivocal.[62, 67] A few studies have evaluated the sustainability of improvements in physicians' practices or patient outcomes after a pain or non-pain

symptom management curriculum, and evidence is doubtful.[68, 69] For instance, an observational study showed the durability of effects on attitudes and knowledge after the fourth and twelfth months of a taught cancer pain management program for physicians, nurses, and pharmacists.[68] However, another study reported that residents' ability to convert oral and intravenous formulations of opioids was not retained knowledge after six months of a protected block curriculum for emergency medicine trainees.[69] This review recognises an enormous lack of evidence for evaluating if educational interventions directly support patients and families' needs at the end of life.

Our review has strengths and limitations. BEME Collaboration guidance was followed throughout the preparation of this review to enhance the quality of medical education systematic reviews.[21] We followed an orderly process from the development of the protocol to the final review. The search was not limited by language, year of publication, or geographical location. Included studies were however all conducted in developed countries with national palliative care programs and frameworks of EOL care competencies for non-palliative specialities. Our findings are therefore not generalizable for countries and hospitals where palliative medicine is not well-integrated in primary, secondary or tertiary levels, and few palliative care providers exist yet. Use of recommended tools such as the BEME data sheet and quality indicator tools helped to capture the major factors relevant educational research appraisal. Therefore, findings from this review will be comparable with other medical education reviews. Furthermore, risk of bias was assessed using the tools recommended by the Cochrane Collaboration, which allowed a more rigorous process in the methodological appraisal.

Our findings have implications for research. We identified different educational methods that can be implemented in settings with a well-integrated palliative care team across different specialities, and the main symptom management topics relevant to most of medical specialities. Both findings can contribute to the academy development and improve postgraduate curriculums in managing symptoms. Furthermore, we described factors that can influence the residents' educational outcomes such as previous EOL care training, which allows the identification of students might derive most benefit from training in EOL

issues. This review identified the need for more rigorous research designs in this field, including the use of psychometrically sound evaluation instruments to uncover changes in trainees' learning outcomes. Inclusion of additional methods such as OSCE, standardised patient, mini CEX, patient or family assessment could extend the impact on symptom management evaluation of the educational interventions on the "shows how" and "does" competencies of the Miller's pyramid.[27] Focus groups and interviews can provide detailed views from trainees, and findings can be triangulated.[60] Qualitative methodologies allow for triangulation of data and to capture the complexity of the educational interventions.[47] More studies are needed in settings where palliative care is still not integrated in routine practice to evaluate the feasibility of educational curriculums in these scenarios. Finally, further research should evaluate the impact of symptom management training on physicians and organizations performs, and on the experience, quality of life and satisfaction of patients or relatives. It is essential to determine if medical education is achieving the major goal of palliative care, relieving the suffering of patients at the EOL.

CONCLUSION

Preparation of the generalist to provide EoLC has never been more important, with an increasing number of people dying particularly with non-cancer disease associated with frailty and multi-morbidity. Nevertheless, this review found few controlled studies examining the effectiveness of symptom management training for physician generalist providers of palliative care. Current evidence suggests such training can improve trainees' attitudes and knowledge. However, the transferability of this learning to the workplace, and the impact on patient-reported outcomes is under-studied. Our review also highlights the enormous need for more robust evidence and validated outcomes measures to establish educational approaches in palliative and end of life care more generally.

DISCLOSURE AND ACKNOWLEDGMENTS

The authors thank colleagues at the Cicely Saunders Institute; Lisa Brighton for strategic support, Mark Willis for technical help, and Alanah Wilkinson for language editing. The authors also thank Camilo Torres for his intellectual discussions on medical education and curriculum.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors have no intellectual passion, political, religious and institutional affiliations that might lead to a conflict of interest in making this paper.

REFERENCES

1. Alliance WPC and Organization WH. Global atlas of palliative care at the end of life. *London: Worldwide Palliative Care Alliance*. 2014.
2. Lipar T. End of Life Care Strategy-promoting high quality care for all adults at the end of life. *Kakovostna Starost*. 2013; 16: 44.
3. Higginson IJ, Shipman C, Gysels M, et al. Scoping exercise on generalist services for adults at the end of life: research, knowledge, policy and future research needs. *London: National Coordinating Centre for Service Delivery and Organisation (NCCSDO)*. 2007.
4. Schaefer KG, Chittenden EH, Sullivan AM, et al. Raising the bar for the care of seriously ill patients: results of a national survey to define essential palliative care competencies for medical students and residents. *Academic Medicine*. 2014; 89: 1024-31.
5. Gamondi C, Larkin P and Payne S. Core competencies in palliative care: an EAPC white paper on palliative care education: part 2. *European Journal of palliative care*. 2013.
6. Mitchell GK. How well do general practitioners deliver palliative care? A systematic review. *Palliative medicine*. 2002; 16: 457-64.
7. Lupu D. Estimate of current hospice and palliative medicine physician workforce shortage. *Journal of pain and symptom management*. 2010; 40: 899-911.
8. Quill TE and Abernethy AP. Generalist plus specialist palliative care—creating a more sustainable model. *New England Journal of Medicine*. 2013; 368: 1173-5.
9. Wilson E, Morbey H, Brown J, Payne S, Seale C and Seymour J. Administering anticipatory medications in end-of-life care: A qualitative study of nursing practice in the community and in nursing homes. *Palliative Medicine*. 2015; 29: 60-70.
10. Higginson IJ, Gomes B, Calanzani N, et al. Priorities for treatment, care and information if faced with serious illness: A comparative population-based survey in seven European countries. *Palliative Medicine*. 2013.

11. Shaw EA, Marshall D, Howard M, Taniguchi A, Winemaker S and Burns S. A systematic review of postgraduate palliative care curricula. *Journal of palliative medicine*. 2010; 13: 1091-108.
12. Richman PS, Saft HL, Messina CR, et al. Palliative and end-of-life educational practices in US pulmonary and critical care training programs. *Journal of Critical Care*. 2016; 31: 172-7.
13. Tait GR and Hodges BD. End-of-life care education for psychiatric residents: attitudes, preparedness, and conceptualizations of dignity. *Academic Psychiatry*. 2009; 33: 451-6.
14. Mahtani R, Kurahashi AM, Buchman S, Webster F, Husain A and Goldman R. Are family medicine residents adequately trained to deliver palliative care? *Canadian Family Physician*. 2015; 61: e577-82.
15. Thomas RA, Curley B, Wen S, Zhang J, Abraham J and Moss AH. Palliative Care Training during Fellowship: A National Survey of U.S. Hematology and Oncology Fellows. *Journal of Palliative Medicine*. 2015; 18: 747-51.
16. Moens K, Higginson IJ, Harding R, et al. Are there differences in the prevalence of palliative care-related problems in people living with advanced cancer and eight non-cancer conditions? A systematic review. *Journal of pain and symptom management*. 2014; 48: 660-77.
17. Solano JP, Gomes B and Higginson IJ. A comparison of symptom prevalence in far advanced cancer, AIDS, heart disease, chronic obstructive pulmonary disease and renal disease. *Journal of pain and symptom management*. 2006; 31: 58-69.
18. C G, P L and S P. Core competencies in palliative care: an EAPC white paper on palliative care education: part 1. *European Journal of Palliative Care*.
19. Kottewar SA, Bearelly D, Bearelly S, Johnson ED and Fleming DA. Residents' End-of-Life Training Experience: A Literature Review of Interventions. *Journal of Palliative Medicine*. 2014; 17: 725-32.
20. Weissman DE and Block SD. ACGME Requirements for End‐of‐life Training in Selected Residency and Fellowship Programs: A Status Report. *Academic Medicine*. 2002; 77: 299-304.
21. Hammick M, Dornan T and Steinert Y. Conducting a best evidence systematic review. Part 1: From idea to data coding. BEME Guide No. 13. *Medical teacher*. 2010; 32: 3-15.
22. Faux D. Beme Guide No 3:: Systematic Searching For Evidence In Medical Education: Part 2: Constructing Searches. *Education for Primary Care*. 2004; 15: 121.
23. Haig A and Dozier M. BEME Guide no 3: systematic searching for evidence in medical education--Part 1: Sources of information. *Medical teacher*. 2003; 25: 352-63.
24. Gordon M and Gibbs T. STORIES statement: publication standards for healthcare education evidence synthesis. *BMC medicine*. 2014; 12: 143.
25. Charrois TL. Systematic reviews: what do you need to know to get started? *The Canadian journal of hospital pharmacy*. 2015; 68: 144.
26. Antunes B, Harding R, Higginson IJ and EUROIMPACT. Implementing patient-reported outcome measures in palliative care clinical practice: a systematic review of facilitators and barriers. *Palliative medicine*. 2014; 28: 158-75.
27. Epstein RM. Assessment in medical education. *New England Journal of Medicine*. 2007; 356: 387-96.

28. Frey RA, Gott M and Neil H. Instruments used to measure the effectiveness of palliative care education initiatives at the undergraduate level: a critical literature review. *BMJ supportive & palliative care*. 2012: bmjspcare-2012-000306.
29. Gorman TE, Ahern SP, Wiseman J and Skrobik Y. Residents' end-of-life decision making with adult hospitalized patients: A review of the literature. *Academic Medicine*. 2005; 80: 622-33.
30. Frey R, Gott M and Banfield R. What indicators are measured by tools designed to address palliative care competence among 'generalist' palliative care providers? a critical literature review. *Progress in Palliative Care*. 2011; 19: 114-24.
31. Sullivan AM, Lakoma MD and Block SD. The status of medical education in end‐of‐life care. *Journal of general internal medicine*. 2003; 18: 685-95.
32. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews*. 2015; 4: 1.
33. Collaboration B. BEME Coding Sheet-BEME Collaboration. *viewed< www bemecollaboration org/downloads/749/beme4_appx1 pdf*. 2012.
34. Buckley S, Coleman J, Davison I, et al. The educational effects of portfolios on undergraduate student learning: a Best Evidence Medical Education (BEME) systematic review. BEME Guide No. 11. *Medical teacher*. 2009; 31: 282-98.
35. Barrett A, Galvin R, Steinert Y, et al. A BEME (Best Evidence in Medical Education) systematic review of the use of workplace-based assessment in identifying and remediating poor performance among postgraduate medical trainees. *Systematic reviews*. 2015; 4: 65.
36. Higgins JP, Altman DG, Gøtzsche PC, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *Bmj*. 2011; 343: d5928.
37. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. *Bmj*. 2016; 355: i4919.
38. Higginson IJ, Finlay IG, Goodwin DM, et al. Is there evidence that palliative care teams alter end-of-life experiences of patients and their caregivers? *Journal of pain and symptom management*. 2003; 25: 150-68.
39. Mitchell AJ, Chan M, Bhatti H, et al. Prevalence of depression, anxiety, and adjustment disorder in oncological, haematological, and palliative-care settings: a meta-analysis of 94 interview-based studies. *The lancet oncology*. 2011; 12: 160-74.
40. Zhang Y and Wildemuth BM. Qualitative analysis of content. *Applications of social research methods to questions in information and library science*. 2016; 318.
41. Barnett MD, Maurer SH and Wood GJ. Pediatric Palliative Care Pilot Curriculum: Impact of "Pain Cards" on Resident Education. *The American journal of hospice & palliative care*. 2016; 33: 829-33.
42. Bradley CT, Webb TP, Schmitz CC, Chipman JG and Brasel KJ. Structured teaching versus experiential learning of palliative care for surgical residents. *The American Journal of Surgery*. 2010; 200: 542-7.
43. Claxton R and Arnold R. Educational impact of weekly e-mailed Fast Facts and Concepts (318-A). *Journal of Pain and Symptom Management*. 2011; 41 (1): 201-2.
44. Mikhael J, Baker L and Downar J. Using a pocket card to improve end-of-life care on internal medicine clinical teaching units: a cluster-randomized controlled trial. *Journal of General Internal Medicine*. 2008; 23: 1222-7.

45. Okon TR, Evans JM, Gomez CF and Blackhall LJ. Palliative educational outcome with implementation of PEACE tool integrated clinical pathway. *Journal of Palliative Medicine*. 2004; 7: 279-95.
46. Olden AM, Quill TE, Bordley D and Ladwig S. Evaluation of a required palliative care rotation for internal medicine residents. *Journal of Palliative Medicine*. 2009; 12: 150-4.
47. Steinert Y, Mann K, Centeno A, et al. A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education: BEME Guide No. 8. *Medical teacher*. 2006; 28: 497-526.
48. Balkin EM, Ort K, Goldsby R, Duvall J and Kim CD. Pocket Reference Card Improves Pediatric Resident Comfort in Caring for Children at End of Life. *Journal of Palliative Medicine*. 2017; 20: 409-14.
49. Jarabek BR, Jama AA, Cha SS, Ruegg SR, Moynihan TJ and McDonald FS. Use of a palliative care order set to improve resident comfort with symptom management in palliative care. *Palliative Medicine*. 2008; 22: 343-9.
50. Dy SM, Hughes M, Weiss C and Sisson S. Evaluation of a web-based palliative care pain management module for housestaff. *Journal of Pain & Symptom Management*. 2008; 36: 596-603.
51. Cook DA, Levinson AJ, Garside S, Dupras DM, Erwin PJ and Montori VM. Internet-based learning in the health professions: a meta-analysis. *Jama*. 2008; 300: 1181-96.
52. Yacht AC, Suglia SF and Orlander JD. Evaluating an end-of-life curriculum in a medical residency program. *American Journal of Hospice & Palliative Medicine*. 2006; 23: 439-46.
53. Oneschuk D, Fainsinger R, Hanson J and Bruera E. Assessment and knowledge in palliative care in second year family medicine residents. *Journal of Pain & Symptom Management*. 1997; 14: 265-73.
54. Irwin SA, Montross LP, Bhat RG, Nelesen RA and von Gunten CF. Psychiatry resident education in palliative care: opportunities, desired training, and outcomes of a targeted educational intervention. *Psychosomatics*. 2011; 52: 530-6.
55. Duong PH and Zulian GB. Impact of a postgraduate six-month rotation in palliative care on knowledge and attitudes of junior residents. *Palliative Medicine*. 2006; 20: 551-6.
56. Harris LL, Placencia FX, Arnold JL, Minard CG, Harris TB and Haidet PM. A Structured End-of-Life Curriculum for Neonatal–Perinatal Postdoctoral Fellows. *American Journal of Hospice & Palliative Medicine*. 2015; 32: 253-61.
57. Cook DA, Hatala R, Brydges R, et al. Technology-enhanced simulation for health professions education: a systematic review and meta-analysis. *Jama*. 2011; 306: 978-88.
58. Selman LE, Brighton LJ, Hawkins A, et al. The effect of communication skills training for generalist palliative care providers on patient-reported outcomes and clinician behaviours: a systematic review and meta-analysis. *Journal of pain and symptom management*. 2017.
59. Brock KE, Cohen HJ, Sourkes BM, Good JJ and Halamek LP. Training Pediatric Fellows in Palliative Care: A Pilot Comparison of Simulation Training and Didactic Education. *Journal of Palliative Medicine*. 2017; 24: 24.

60. Morrison J. Evaluation. *Bmj*. 2003; 326: 385-7.
61. Brighton LJ, Koffman J, Hawkins A, et al. A systematic review of end of life care communication skills training for generalist palliative care providers: research quality and reporting guidance. *Journal of pain and symptom management*. 2017.
62. Ury WA, Rahn M, Tolentino V, et al. Can a pain management and palliative care curriculum improve the opioid prescribing practices of medical residents? *Journal of General Internal Medicine*. 2002; 17: 625-31.
63. Dickson RP, Engelberg RA, Back AL, Ford DW and Curtis JR. Internal medicine trainee self-assessments of end-of-life communication skills do not predict assessments of patients, families, or clinician-evaluators. *Journal of Palliative Medicine*. 2012; 15: 418-26.
64. Davis DA, Mazmanian PE, Fordis M, Van Harrison R, Thorpe KE and Perrier L. Accuracy of physician self-assessment compared with observed measures of competence: a systematic review. *Jama*. 2006; 296: 1094-102.
65. Fischer SM, Gozansky WS, Kutner JS, Chomiak A and Kramer A. Palliative care education: an intervention to improve medical residents' knowledge and attitudes. *Journal of Palliative Medicine*. 2003; 6: 391-9.
66. Schuh LA, Biondo A, An A, et al. Neurology resident learning in an end-of-life/palliative care course. *Journal of Palliative Medicine*. 2007; 10: 178-81.
67. von Gunten CF, Mullan PB, Nelesen R, et al. Primary Care Residents Improve Knowledge, Skills, Attitudes, and Practice After a Clinical Curriculum With a Hospice. *American Journal of Hospice & Palliative Medicine*. 2017; 34: 713-20.
68. Janjan NA, Martin CG, Payne R, Dahl JL, Weissman DE and Hill CS. Teaching cancer pain management: durability of educational effects of a role model program. *Cancer*. 1996; 77: 996-1001.
69. DeVader TE and Jeanmonod R. The effect of education in hospice and palliative care on emergency medicine residents' knowledge and referral patterns. *Journal of Palliative Medicine*. 2012; 15: 510-5.

Table 1. Characteristics of included studies.

Author, Year, Country	Design	Participants (n) & setting	Intervention and length	Evaluation Method and Instruments	Key findings (relative to control)	Learning Outcome according to Kirkpatrick's Model	Authors' Conclusion
Barnett, MD 2016 USA	Pre-post test with control group	Pediatrics trainees in PGY 2, 3 and 4 (n=71); Hospital	16-page set of laminated, spiral-bound cards together with a digital copy for smart-phones; 4 conference lectures on pain management, communication of bad news and prognosis, the dying process, and end-of-life symptoms; 3 self-directed case studies during a 1-week palliative care rotation. Delivered across 1 academic year (PGY 2)	Survey of self-reported comfort, 5-point Likert scale (1=least comfortable, 5=most comfortable) Questionnaire of knowledge; true/false statements, and MCQ	**Significance difference** (post-test): Total comfort in pain and symptom domain (p=0.02); providing pain control (p=0.03); providing care for nausea (p=0.02); managing agitation & delirium (p=0.02); recognizing signs of impending death (p=0.03); Knowledge on: Fentanyl dosing (p=0.03); suctioning for end-of-life secretions (p=0.03); treatment for hyperactive delirium (p=0.03). **No significance difference** (post-test): Comfort on providing bowel & bladder care (p=0.09); managing respiratory symptoms (p=0.08). Knowledge on: total pain score (p=0.66) and total other symptom score (p=0.55).	Reaction (1), Attitudes (2A), Knowledge (2B)	"This longitudinal curriculum... proved to be popular, feasible, and effective at improving comfort with basic palliative care principles."
Bradley, CT 2009 USA	Pre-post test with control group	General and plastic surgery trainees in PGY 2 and 5 (n=13); University Department	Taught sessions: Critical appraisal of literature; Review of 2 journal articles with faculty-moderated discussion; Faculty-moderated discussions with resident interaction and role-play; chaplaincy guest; institutional ethics committee; Quiz bowl–style review of palliative care core content; Discussion of palliative care concepts covered and curriculum design Delivered over 6 hours across 2.5 days (PGY 2)	Survey of residents' perception, Four-point scales (1=strongly agree, 4= strongly disagree) Questionnaire of knowledge, 18 MCQs	**No significant differences** (post-test IG vs pre-test CG): Comfort scores managing non-pain symptoms (p=0.063). **Significant decrease** (post-test IG vs pre-test CG): Comfort scores on managing pain (p<0.0001). **Unknown significant differences**: Knowledge scores on (post tests): Symptom management domain	Attitudes (2A), Knowledge (2B)	"After participating in a palliative care curriculum, they have simulated skills that are similar to chief residents. However, self-confidence is lower among junior residents despite undergoing a palliative care curriculum."

Claxton, R 2011 USA	Randomised controlled trial	Internal Medicine trainees (n=82); Hospital	Weekly email containing two "Fast Facts and Concepts": a 1-page, practical, peer-reviewed, evidence-based summaries of key palliative care topics (pain management, symptom management, communication, end-of-life decision making, professionalism). Delivered over 32 weeks	Survey of preparedness; 4-point Likert scale ("not prepared at all" to "very prepared") Questionnaire of knowledge; 24 MCQs	**Significant improvements:** Change in preparedness scores on: converting between opioids (p=0.04); starting a patient-controlled analgesia device (p=0.02); differentiating between somatic, visceral, and neuropathic pain (p=0.01); treating nausea and vomiting (p=0.02). Change in Knowledge scores on: pain management domain (p<0.05); appropriate route for administration of opioids (p=0.02); risks and benefits of methadone (p=0.02); treating symptoms at end of life (p=0.02). **No significant difference:** Change in knowledge on delirium management (p>0.05).	Attitudes (2A), Knowledge (2B)	"…an educational intervention that increases intern medical knowledge and self-reported preparedness in symptom management skills, but not preparedness in communication skills or satisfaction with palliative care education."
Mikhael, J 2008 Canada	Cluster randomised controlled trial	Multiple specialities trainees: Internal Medicine, Surgery, Family Medicine, Radiation oncology, Neurology, Psychiatry, and Pathology, all PGY (n=136); Hospitals	Pocket reference including information about pain and symptom control; 1–2 didactic end-of-life teaching sessions per month normally given as part of the rotation CG: didactic sessions only. Delivered over 1-2 months	Focus group, Survey of comfort; 5-point Likert scale (1=very uncomfortable, 5=very comfortable), Questionnaire of knowledge; 5 MCQs	**Significant improvement:** Change in comfort scores overall (p=0.01) and assessing a patient's pain level (p=0.02). Change in knowledge scores overall (p<0.05) and dose-equivalence oral and parenteral morphine (p<0.01). **No significant differences:** Change in comfort scores on: dosing morphine fore severe pain (p=0.06); treating nausea at the end-of-life (p=0.06); treating agitation at the end-of-life (p=0.39). Change in knowledge scores on adjuvant medication for treating neuropathic pain; first-line drugs for opioid-induced nausea; composition of Thylenol; and breakthrough (PRN) doses of oral opiates (p>0.05).	Reaction (1), Attitudes (2A), Knowledge (2B)	"Our pocket card is a feasible, economical, and educational intervention that improves resident comfort level and knowledge in delivering end-of-life care on CTUs."
Okon, TR 2004 USA	Pre-post test with control group	Internal Medicine trainees in PGY 1, 2 and 3 (n=54); Hospital	Experiential learning intervention "PEACE" covering physical symptoms, emotive and cognitive symptoms, autonomy and agency, communication, economic, and transcendency, offered during an integrated end-of-life clinical pathway, including a 32-page comprehensive daily progress form. Delivered over 4 week (PGY 1)	Survey; 5-point Likert scale (1=strongly disagree to 5=strongly agree), Questionnaire of knowledge; 16 MCQs	**Significant improvement:** Change in total knowledge score (p<0.001)	Attitudes (2A), Knowledge and skills (2B)	"A time-effective, practice-based strategy led to a significant improvement in knowledge of end-of-life care... Factual knowledge improved slightly with standard, pre-intervention training and experience."

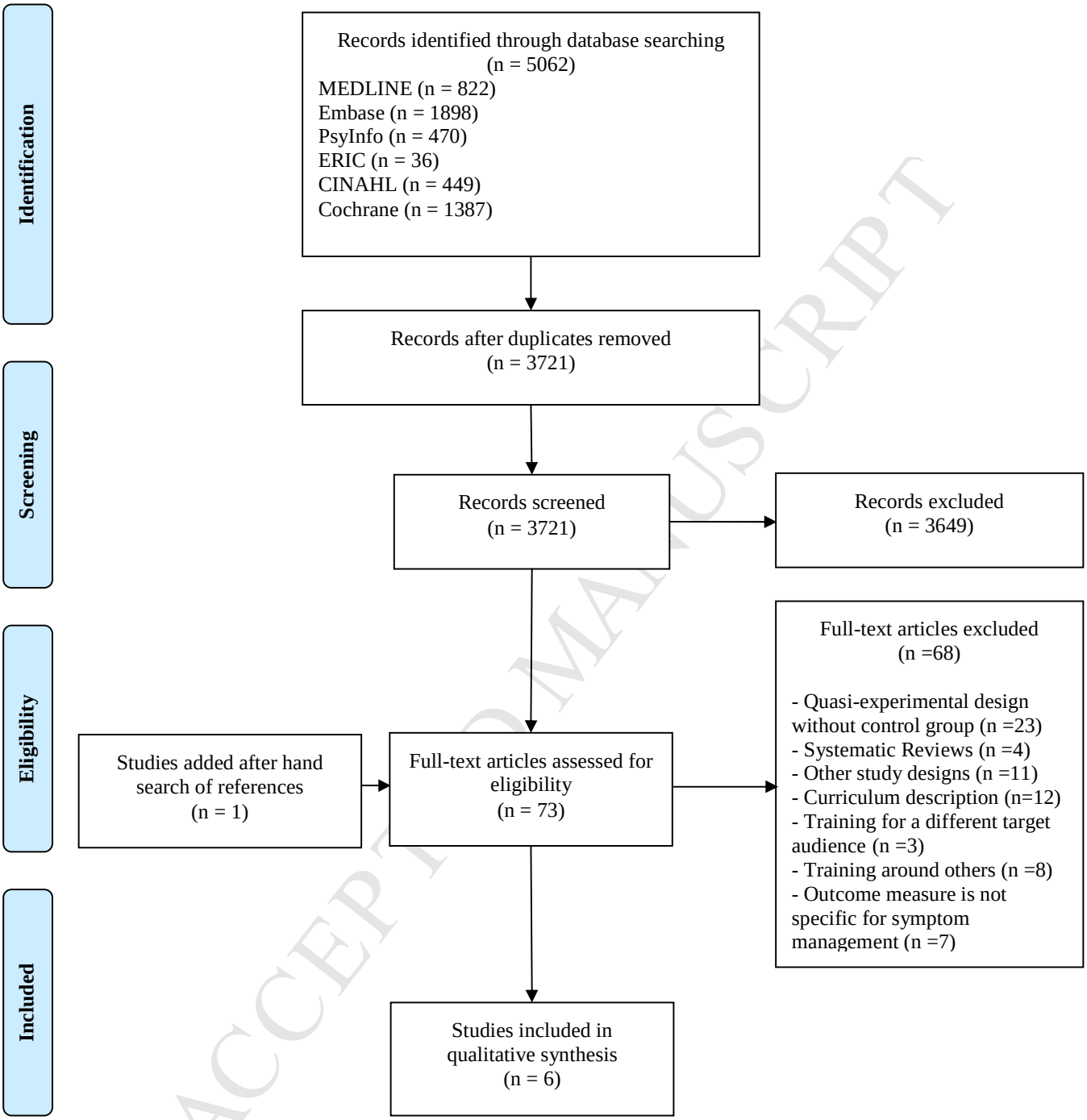
Olden, MD 2009 USA	Pre-post test with control group	Internal Medicine trainees in PGY 1, 2 and 3 (n=59); Hospital	2-week rotation in a busy inpatient; palliative care consult service; Attendance at the weekly interdisciplinary group meeting and palliative care conferences; Free copy of the Primer of Palliative Care & workbook. Delivered over 2 weeks (PGY 2)	Questionnaire of knowledge; 36 questions	**Unclear significance differences**: Non-pain symptom management scores PGY2 > PGY3 > PGY1	Knowledge and skills (2B)	"Palliative care knowledge, as tested by objective examination, improves during internal medicine residency at our institution and specifically over the course of a required, 2-week palliative care rotation."

Post Graduate Year (PGY): Intervention Group (IG); Control Group (CG); *common pre-test score; Multiple Choice Question (MCQ)

Table 2. Methodological quality of included studies

Author, year	Research question	Study subjects	Data Collection Methods	Completeness of data	Risk of bias assessment (Cochrane tool)*	Analysis of results	Conclusions	Reproducibility	Prospective	Ethical issues	Triangulation	Global rating
Barnett 2016	Yes	Yes	Unclear	No	Serious	Unclear	Unclear	Yes	Yes	Yes	No	5
Bradley 2009	Yes	Unclear	Unclear	Yes	Serious	Unclear	Unclear	Yes	Yes	Yes	No	5
Claxton 2011	Yes	Unclear	Unclear	Yes	High	Yes	Unclear	Yes	Yes	Yes	No	6
Mikhael 2008	Yes	Unclear	No	Yes	High	No	Unclear	Yes	Yes	Yes	Yes	6
Okon 2004	Yes	Yes	Unclear	Yes	Serious	Unclear	Unclear	Yes	Yes	Yes	No	6
Olden 2009	Yes	Unclear	Yes	Yes	Serious	Unclear	Unclear	Yes	Yes	Yes	No	6

Response to each category: Yes (clearly stated), No (not stated) or Unclear (answer partially the question or not explicit). Global rating: Number of questions answered with a "Yes". High quality studies are considered those that meet a minimum of seven of the eleven indicators. * Risk of bias: "High risk of bias" will be considered as "No", and "Low or moderate risk of bias" as "Yes" using Cochrane tools for evaluating risk of bias in RCTs. Serious or critical risk of bias will be considered as "No", and "Low or moderate risk of bias" as "Yes" using ROBINS-1 for non-randomised studies of intervention.



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

BOX S1: Content of training interventions beyond symptom management

Communication of bad news and prognosis: children & families[41-43, 46]

Communication[43, 45, 46]

End-of-life decision making[43]

Autonomy[45]

Emotive and cognitive symptoms[45]

Patient and family support & spirituality & family presence at resuscitation[42]

Ethical issues &interaction with palliative care in the surgical intensive care unit[42]

Prognosis[41, 46]

Risks and benefits of aggressive treatment[46]

Do not resuscitation[46]

Sedation management[44]

Dying process[41]

Grief[45]

Professionalism[43, 46]

Terminal care & Hospice systems[42, 46]

Psychosocial issues[41]

Economic[45]

1. exp Palliative Care/
2 palliat*.mp.
3 exp Terminal Care/
4 terminal*.mp.
5 exp Hospices/
6 hospice*.mp.
7 end of life.mp.
8 end-of-life.mp.
9 eol care.mp.
10 exp Palliative Medicine/
11 end stage*.mp.
12 end-stage.mp.
13 dying.mp.
14 advanced disease.mp.
15 advanced cancer.mp.
16 advanced illness.mp.
17 limited life span*.mp.
18 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17. ti, ab, kw
19 exp Educational Measurement/
20 educat*.mp.
21 exp Education, Medical/
22 training.mp.
23 train*.mp.
24 exp Teaching/
25 exp Program Evaluation/
26 course*.mp.
27 workshop.mp.
28 exp Clinical Competence/
29 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 . ti, ab, kw
30 resident*.mp.
31 trainee*.mp.
32 fellow*.mp.
33 30 or 31 or 32. . ti, ab, kw
34 medic*.mp.
35 33 and 34. . ti, ab, kw
36 18 and 29 and 35. . ti, ab, kw

Figure S1. Example search strategy (MEDLINE)

Table S1. Kirkpatrick' model for evaluating educational outcomes.

Level 1	REACTION	Participants' views on the learning experience, its organization, presentation, content, teaching methods and quality of instruction
Level 2A	LEARNING Change in attitudes	Changes in the attitudes or perceptions among participant groups towards teaching and learning
Level 2B	LEARNING Modification of Knowledge or skills	For *knowledge*, this relates to the acquisition of concepts, procedures and principles; For *skills*, this relates to the acquisition of thinking/problem-solving, psychomotor and social skills
Level 3	BEHAVIOUR Change in Behaviours	Transference of learning to the workplace or willingness of learners to apply new knowledge and skills
Level 4A	RESULTS Change in the system/organizational practice	Widespread changes in the organization, attributable to the educational program
Level 4B	RESULTS Change among the participants, students, residents or colleagues	Improvement in student or resident learning/performance as a direct result of the educational intervention

Table S2. Risk of bias of Randomised Controlled Trials (RCTs)

Author, year of publication	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other: Contamination bias	Risk of bias
Claxton 2011	Unclear	Unclear	High	Low	Unclear	Low	Unclear	High
Mikhael 2008	Unclear	Low	High	Low	Low	Low	Unclear	High

Table S3 **Risk of Bias of Non-Randomised Studies of Interventions (ROBINS-I)**

First author, year of publication	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Risk of bias
Barnett 2016	Moderate	Moderate	Low to Moderate	Low to Moderate	Serious	Low	Low to moderate	Serious
Bradley 2009	Moderate to serious	Moderate	Low	Moderate	Low	Low	Low to moderate	Serious
Okon 2004	Moderate to serious	Moderate	Low to Moderate	Low to Moderate	Low	Low	Moderate	Serious
Olden 2009	Moderate to serious	Unclear	Low	Moderate	Low	Low	Low to Moderate	Serious

ABSTRACT

Context. Symptom management is a priority area within palliative care core competencies for generalist providers. While several educational initiatives exist, a comprehensive evidence synthesis on the effectiveness of symptom management training on trainees' learning and patient-reported outcomes is lacking.

Objectives. To determine the effectiveness of training in symptom management in palliative care providers in non-palliative specialities.

Methods. A systematic review following Best Evidence Medical Education (BEME) methods from searches of MEDLINE, EMBASE, ERIC, CINAHL, PsycINFO, Cochrane database of systematic, Clinical Trials.gov and ISRCTN databases to September 2017. Prospective controlled studies testing the impact of symptom management educational interventions on physicians in training in non-palliative specialities were included. Data were summarised narratively, grouped by curriculum description, and effectiveness on trainees' learning or patient-reported outcomes.

Results. Of 5062 records identified, 6 studies met the inclusion criteria: two randomised controlled trials and four quasi-experimental. Pain management, use of opioids and their side effects were most frequently covered. Clinical decision support tools, web-based teaching, palliative care rotation and mixed educational methods were used. Most studies used self-reported, original or modified evaluation instruments, though psychometric properties were seldom reported. Despite methodological considerations, all educational methods improved trainees' learning outcomes. However, the effects on trainees' behaviour and patient-related outcomes were not evaluated.

Conclusion. Current educational training programmes in symptom management appear to improve trainees' comfort, preparedness, and knowledge in assessing and managing patients' symptoms at the end of life. More rigorous research to evaluate the impact of this training on residents and organisational performance is now required.

Key words

education, end of life care, palliative care, trainees, symptom management

BOX 1: Summary of content in pain and symptom management

Pain management[41-46]	Fundamentals of pain management[41] Common paediatric pain medications[41] Opioids types and dosage[41, 43, 44] Dose conversion[41, 43, 44, 46] Choosing an opioid[41, 43] Breakthrough dosing[41, 43, 44] Patient-controlled analgesia (PCA)[41, 43] Opioids adverse effects[41, 43, 44] Opioids use in renal failure[43] Analgesics Order[43] Fentanyl patch[41, 44] Methadone[43] Lidocaine patch[43] Neuropathic pain management[41, 43, 44] Biphosphonates for bone pain[43] Adjuvant therapies for pain[41]
Pain assessment[41, 43]	Needs of symptoms assessment[45] Paediatric pain assessment[41] Pain assessment in the cognitively impairment[43]
Non-pain symptoms management[41-46]	Needs of symptoms assessment[45] Nausea and vomiting[41, 43-45] Appetite loss[45] Dry mouth[45] Constipation[41, 43, 44] Diarrhoea[43, 45] Bowel and upper gastrointestinal obstruction[43] Delirium/ Agitation[41, 43] Energy loss[45] Dyspnea[41, 45] Opioids and non-opioids for cough[43, 45] Urinary retention[41] Incontinence[45] Pruritus[41, 45] Sores/ulceration[45] Hypercalcemia of malignancy[43] Syndrome of imminent death[43] Terminal secretions[41, 43] Palliative sedation[43, 44] Side effects of treatment[45]